

22 NEWS

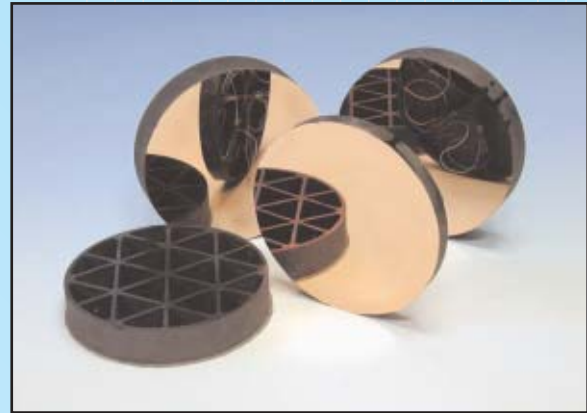
Research Highlight

Nanolaminate Mirrors for Space-based Observation Systems. NA-22 is funding work on advanced designs for ultra-lightweight mirrors for space-based telescopes. The project will combine previous work on nanolaminate materials with integrated microactuators and other precision components currently being developed for future ground- and space-based observation platforms for various national security applications.

Nanolaminates are precision-engineered materials created by sputtering alternating layers of mixtures of atoms onto a precisely shaped form and building up hundreds to tens of thousands of these layers. The result is an ultra-thin, freestanding surface that is mechanically very strong, highly reflective, and can scale in size. When bonded to a rigid substructure with discrete actuators to correct surface deformations, the resulting nanolaminate mirrors are nearly an order of magnitude less in mass per unit area when compared with traditional telescope mirrors formed by casting, grinding, polishing, and coating glass blanks.

Nanolaminates are also fabricated comparatively rapidly and in quantity, creating a more responsive, less costly production process. By integrating microactuators directly into the nanolaminate structure itself, further reductions in overall mass are possible, enabling new applications of this technology in optical designs and an even greater savings in terms of deployment, especially for space, but also for unattended airborne vehicles and other platforms. If this technique had been available when the Hubble was built, not only could the mirrors have been fabricated in months not years, but space lift costs would have been discounted at least 75%.

Lawrence Livermore National Laboratory maintains a nanolaminate fabrication facility headed by Dr. Troy Barbee, Jr., of the Lab's Advanced Materials Program.

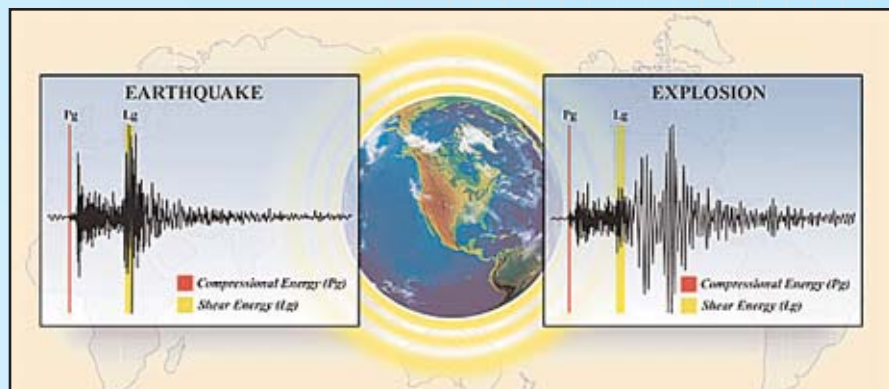


Recent Events

Every September, NNSA and the Air Force Research Laboratory (AFRL) sponsor a joint review of research of technology developments in ground-based, nuclear-explosion-monitoring (GNEM). This year, the "26th Seismic Research Review" was held in Orlando, Florida, and NA-22's resident seismologist, Dr. Raymond J. Willemann, presented the theme paper, "Trends in Nuclear Explosion Monitoring." Synergy was the name of the game as more than 200 participants from industry, university, the DOE national laboratories, other government agencies, and interested international researchers discussed new and newsworthy developments and conversed around their posters dedicated to the topic. The proceedings, available at

www.nemre.nnsa.doe.gov/cgi-bin/prod/srr/index.cgi, represent more than just year-end contract deliverables; they also reflect a coordinated effort to bring together the community and thereby create a planning opportunity. Once again, researchers from

universities and private industry had an opportunity in Florida to discuss their ideas with cognizant federal officials and also had a chance to collaborate on future proposals for joint extramural research efforts in GNEM R&E.



Awards to DOE Laboratories for NA-22-Originated Work

Last month's edition of the *NNSA News* reported on several R&D 100 awards won by the three NNSA laboratories. While in 2003 DOE and DOE/NNSA labs won six awards for work begun by NA-22, this year there were three. At a black-tie event in Chicago on October 14th, Lawrence Livermore National Laboratory was awarded one of its five "Oscars of Invention" for the Autonomous Pathogen Detection System (APDS). This automated, podium-sized device represents substantial investment begun by NA-22 almost six years ago under the auspices of a program subsequently transferred to the Department of Homeland Security. It is capable of remote and unattended operation. Targeted for civilian applications in which the public is at high risk of exposure (subway systems, large office complexes, convention centers etc.), the APDS will be part of a monitoring network and integrated into wide-area monitoring.

Pacific Northwest National Laboratory won a total of four awards, one of which resulted from work supported by NA-22. Their BSP-3 Polymer is a unique coating that significantly enhances the sensitivity of chemical detection systems by coating the surface of a sensor chip in the detector with a polymer that selectively absorbs discrete vapor molecules. Besides increasing sensitivity to nerve agents, for example, by a factor of four, the coating enables faster detection at lower concentrations than was previously possible.

Oak Ridge National Laboratory's technologies won three separate awards, but SniffEx (a joint entry with others) reflects the support and investment of significant NA-22 assets. A vapor sensor system for detecting and locating a variety of explosives, including plastic-based explosives, SniffEx is based on microtechnology. Specifically, it uses a microcantilever to distinguish discrete frequencies of different vapors, allowing it to reach sensitivities on the order of parts-per-trillion. Along with its high selectivity, direct vapor sensing, low power consumption, compact size, and low cost, the potential applications of this technology will range from counterterrorism, airport safety, and everyday law enforcement to humanitarian efforts such as landmine removal.



Autonomous Pathogen Detection System



SniffEx Explosives Detector (ATF)

Interview with NA 22's "Non-proliferation Graduate Program" intern [<http://ngp.pnl.gov/careers.html>], Reuben Sorensen.



Reuben is completing his Ph.D. dissertation on nuclear fuel cycles based on thorium at the University of Michigan. NA-22 is fortunate to have him dividing his time between us and the Department of Energy's Office of Nuclear Energy.

EP If there were a verification protocol for the Nuclear Nonproliferation Treaty (NPT, in effect since 1970), what would constitute its biggest challenge?

RS The inability to explicitly track fissile materials through the nuclear fuel cycle. The "once-through" cycle as we know it offers would-be proliferators many loopholes to divert and conceal the production of special nuclear material (SNM) that may be used to manufacture nuclear weapons at the so-called "front-end" of the fuel cycle. These "pathways to prolifera-

tion" must be closed. Once producing SNM becomes channeled, ever more precise technologies can be utilized (e.g., suites of radiation detection equipment capable of delayed neutron counts and exact isotopic characterization).

EP What stage of the nuclear fuel cycle do you think is the most difficult to monitor?

RS In the past, nonproliferation efforts focused primarily on the back-end of the fuel cycle—reprocessing. It seems to me, however, that nuclear-fuel enrichment provides more "pathways." Nefarious enrichment facilities feature prominently in today's newspaper. Quite simply, plutonium production, while technically less difficult, is more easily detectable; however, illicit enrichment may yield fewer opportunities for detection.

EP And so what technological solutions do you propose?

RS For environmental and not just non-proliferation reasons—less enrichment—more reprocessing. Waste reduction

(especially long-lived TRUs—transuranics like plutonium), resource/energy conservation, and eliminating greenhouse gases are vital! Instead of continuously asking ourselves whether or not there may be a single (and/or simple) solution to our non-proliferation concerns, I think we must look at the whole, carefully and thoughtfully deploying new technologies ASAP.

22News

Publisher: Jan Cerveny, Assistant Deputy Administrator, NA-22

Editorial: Erich Pieper, NA-22 (202) 586-0112

Production: Gorgiana Alonzo, Kelly Spruiell, Kirk Hadley, and Nancy Rutter
Lawrence Livermore National Laboratory

